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## EXTENSIONS OF REMARKS

November 29, 1977

known at present. One idea mentioned in the panel's report is to increase the Earth's albedo (reflectivity) so as to absorb less solar radiation; this could be done, in principle, by spreading large quantities of small reflecting platelets of latex over the ocean surface—however, the pile-up of billions of platelets on the world's beaches is an easily predicted and environmentally undesirable side-effect.

The panel states that it is not yet known whether climatic changes occur in fairly discrete, "steplike" shifts from one dynamically stable state to another, or if they take place by a gradual passage through a continuum of states. The steplike transition would be especially worrisome, because seemingly minor changes might bring on an abrupt change in climate. An even more suitable problem for the physicist is to determine what contributions to the world's energy needs can be expected from the various "renewable" (sometimes called "inexhaustible") resources.

More accurate measurements of a number of parameters in the energy-climate problem are needed. The variation with time of the ratio of C<sup>12</sup> to C<sup>13</sup> in the atmosphere must be measured over a wide range of geographic locations to learn the net flux of CO<sub>2</sub> between the atmosphere and the biosphere, says the panel, because the changes in C<sup>12</sup>-C<sup>13</sup> ratio are likely to be small compared to random errors. Other measurements the panel deems necessary include:

Better estimates of changes in land use;  
Estimated annual changes in global forest biomass;

Determination of changes in carbon content of soil humus;

Intercomparable mean monthly values of the partial pressure for CO<sub>2</sub> in the atmosphere, the ocean surface and subsurface waters;

Refined estimates of the quantities of CO<sub>2</sub> released by the burning of fossil fuels;

The dispersal of tritium from atmospheric nuclear-weapons tests in subsurface ocean waters (as a measure of advection, convection and turbulent-mixing processes in the ocean), and

Reduction of error in the Suess effect, the decrease of atmospheric radiocarbon content over the century and a half before 1950 due to injection of C<sup>14</sup>-free CO<sub>2</sub> into the atmosphere from combustion of fossil fuels.

**Recommendations.**—The Revelle panel suggests that its study of possible climatic consequences of fossil-fuel use should be only part of a family of similar assessments of the most attractive alternative energy sources' environmental impacts. The panel recommends a "comprehensive worldwide research program" of a uniquely interdisciplinary nature to carry on the investigation of CO<sub>2</sub>-related climatic effects. "Consideration should be given," says their report, "to the establishment at the national level of a mechanism to weave together the interests and capabilities [of scientists and Government agencies] in dealing with climate-related problems." This "Climatic Council," as the panel describes it, would coordinate studies of the CO<sub>2</sub> cycle, energy demand, future population changes and ways of mitigating the effects of global climatic shifts.

Revelle and his colleagues conclude that there are two sorts of counter-measures possible—the reduction of actual climatic changes or adaptation to such changes with a view to minimizing their impact on human life. Adaptation, they say, is the most readily approached; attempts to reduce the climatic effect of additional CO<sub>2</sub> in the atmosphere they find to be "formidably difficult," requiring extended efforts over centuries. With an eye to the future, however, the panel also proposes an intriguing challenge: In light of the expanding knowledge and in-

terest in climatic changes, they say, "perhaps the question that should be addressed soon is 'What should the atmospheric carbon dioxide content be over the next century or two to achieve an optimum global climate?'"

## HOW FAST CAN WE SAFELY BURN COAL?

HON. BOB WILSON

OF CALIFORNIA

IN THE HOUSE OF REPRESENTATIVES

Tuesday, November 29, 1977

Mr. BOB WILSON. Mr. Speaker, under leave to extend my remarks in the RECORD, I include the following:

[From the Oak Ridge National Laboratory Review, fall 1977]

CARBON DIOXIDE AND CLIMATE—HOW FAST CAN WE SAFELY BURN COAL?

SOME SCENARIOS FOR THE YEAR 2040

(By Carolyn Krause)

For the first time in years, the White House has not received a Fraser balsam fir from the Blue Ridge Mountains for its official Christmas tree. A change in climate there and in the Great Smoky Mountains has caused these outlying areas of Maritime Canada climate to warm up. The warmer climate is unsuitable for the fir trees and, furthermore, favors a devastating insect pest—the balsam wooly aphid—to hasten destruction of the fir forests. The Fraser fir is in danger of becoming extinct, and forest rangers and national park officials are worried that the aphid will start to work on a new host—the red spruce trees which, along with the firs, have thrived for hundreds of thousands of years in these mountains.

In the Great Plains, wheat farmers who have not been wiped out financially by dust-bowl storms are contemplating moving to the cornbelt to raise their crops and establish their silos. They have become persuaded that the cyclic droughts of recent years are part of a permanent trend to warming and drying, not a series of temporary aberrations, so they are preparing for a migration.

Other regions of the world are benefiting from the warming trend. Some deserts bloom in response to greater-than-normal rainfall, for example.

Climatologists attribute the warming trend to the furnaces of civilization which have been spewing forth increasing loads of carbon dioxide to the atmosphere. This colorless and odorless gas, exhaled by man and used by plants to make themselves green, restricts the escape into space of infrared radiation from the sun-warmth earth. Since increased CO<sub>2</sub> absorbs more of the infrared radiation than formerly, a larger amount of heat accumulates, causing a slight but significant increase in average global temperature. This impact of atmospheric CO<sub>2</sub> on climate—dubbed the "greenhouse effect"—has become more apparent in recent years because of the escalating rate at which power plants and industry throughout the world have burned coal, oil from shale, and synthetic oil and gas.

These scenarios may never happen, but they may be within the realm of possibility if the world usage of fossil fuels continues to grow and coal becomes the principal global source of energy. In 1976, Alvin Weinberg, former ORNL Director and now head of the Institute for Energy Analysis at Oak Ridge Associated Universities, warned that a sharp rise in the rate at which the world burns fossil fuel over the next few decades could result in a large increase in atmospheric CO<sub>2</sub> content, which in turn could

boost the surface temperature of the earth enough to have serious economic and ecological implications. The same year, Alex Zucker, ORNL's Associate Director of Physical Sciences, assembled an ad hoc study group to compile a state-of-the-art report on atmospheric CO<sub>2</sub> and climate—a report which would summarize what is known about the problem, what studies are being done, and what research is required to dispel the uncertainties. Appointed to the group were Charlie Baes of the Chemistry Division, group chairman; Jerry Olson of the Environmental Sciences Division, who was already at work on such an assessment and had advocated such a study since the 1960s; Hal Goeller of ORNL's Program Planning and Analyst Office, who has been concerned with resource problems; and Ralph Rotty, meteorologist and engineer at the Institute for Energy Analysis, who has long been concerned with fuels and climatic implications.

In August 1976 the group issued an ORNL report entitled "The Global Carbon Dioxide Problem;" an abbreviated version of this report entitled "Carbon Dioxide and Climate: The Uncontrolled Experiment" was published in the May-June 1977 issue of American Scientist. The message of Weinberg and the Oak Ridge report has not been lost on the Carter Administration which proposed \$3 million for new CO<sub>2</sub>-climate studies in the FY 1978 budget.

GROWTH IN ATMOSPHERIC CO<sub>2</sub>

According to the Oak Ridge report, atmospheric CO<sub>2</sub> has grown steadily from 295 ppm in 1860 (when the Industrial Revolution gathered momentum) to 330 ppm now, an increase of 12 percent. The CO<sub>2</sub> content of the atmosphere has been increasing at 0.2 percent per year since 1958 when regular, accurate measurements commenced. The overall increase has thus far been equivalent to half of the cumulative release of CO<sub>2</sub> from the worldwide combustion of fossil fuels. The other half of the released fossil carbon presumably has been absorbed by the oceans and land biota.

One of the messages of the report is this: If combustion of fossil fuels continues to grow at the historical annual rate of 4.3 percent (an unlikely scenario unless there is a ban on nuclear power), the atmospheric CO<sub>2</sub> concentration could double in 60 years, resulting in an increase in the average global temperature of perhaps 2 to 3°C. On the other hand, a much slower rate of increase of fossil fuel combustion might not affect the climate enough to produce unacceptable changes. So the question that needs to be answered is this: Is there a maximum rate at which we can safely burn oil, gas, and coal without dangerous disturbing the climate?

Answering this question requires more extensive mathematical modeling to determine levels of CO<sub>2</sub> and its distribution among air, oceans, and terrestrial plant life. Mechanisms that must be accounted for in these models, according to the Oak Ridge report, are decreased snow and ice cover (which would result in a decrease in reflected radiation, thus producing additional warming), changes in cloud cover and in the temperature of cloud tops, effects of ocean circulation on CO<sub>2</sub> absorption, and effects of changes in water balance and terrestrial plant life on atmospheric CO<sub>2</sub> levels.

## RECENT COOLING TREND

The earth's surface temperature, which averages 15°C, rose about 0.6°C in the 60 years before 1940. In the past three decades, the earth has undergone a cooling, with its temperature dropping 0.3°C. Some scientists ascribed this slight cooling to industrial pollution, theorizing that airborne particulates can shade the earth by reflecting back incoming solar radiation. (Cool sum-

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mers tend to follow the larger volcanic eruptions for several years because of the dust blown into the stratosphere which settles out slowly.) Industry spews forth both CO<sub>2</sub> and particulates, but the latter's effects are mostly local and likely to remain much less than metrologists are coming to expect from CO<sub>2</sub>. Opposing influences on climate may have been canceling each other's effects lately, giving rise to the controversy over whether the net effects of man's future activities will be a cooling or warming trend.

In recent national meetings on climate or the CO<sub>2</sub> problem, Olson finds scientists generally tending to agree now that discharges of fossil carbon pose substantially more threat to the climate on a global scale than do particles from energy sources. (The particles, incidentally, may absorb some solar radiation, thus adding heat to the atmosphere, but the extent to which this absorption occurs depends on the location and the various particles' optical properties.) Thermal discharges from energy sources, Olson adds, are considered even less of a threat to the next century's global climate, although they could have adverse localized impacts.

There is 10 times as much carbon in the world's fossil fuel reserves as in the atmosphere; or, more specifically, the atmosphere contains  $700 \times 10^9$  metric tons of carbon while the recoverable fossil fuel reserves hold  $7300 \times 10^9$  tons.

The Oak Ridge group considers as a high-use scenario one involving the use of fossil fuel at a growth rate near 4 percent per year for a while followed by an eventual gradual decrease as the supply is used up. In this scenario, roughly half of all fossil carbon resources might be released to the atmosphere in less than 100 years—a situation which could produce many of the consequences mentioned above. In the group's low-use scenario, which might have more acceptable, or at least delayed, consequences, they envision the use of fossil fuel growing at 2 percent of the present rate per year until the year 2025, followed by a decrease as renewable energy sources become available and as fossil fuel use is discouraged. The total fossil carbon released would be 1.5 times the carbon content of the pre-industrial atmosphere, or one-fourth that of the realistic high-use hypothesis.

Olson believes the fossil fuel consumption

pattern that will be adopted will lie somewhere near the high-use rate at first, followed by a struggle to return to a low-use scenario after effects of the excess release are belatedly recognized. How any fossil fuel use scenario will affect man's welfare cannot be predicted until more knowledge is obtained on the carbon cycle, on the likely climatic effects of increasing atmospheric CO<sub>2</sub>, and on the ecological and economic consequences of climate change. How well the various parts of the problem can be organized and solved will challenge the best efforts of all the people and agencies who become involved.

As Roger Revelle and H. E. Suess stated in 1957: "Human beings are now carrying out a large-scale geophysical experiment of a kind that could not have happened in the past nor be repeated in the future. Within a few centuries we are returning to the atmosphere and oceans the concentrated organic carbon stored in the sedimentary rocks over hundreds of millions of years. This experiment, if adequately documented, may yield a far-reaching insight into the processes determining weather and climate."

## HOUSE OF REPRESENTATIVES—Wednesday, November 30, 1977

The House met at 12 o'clock noon.

The Chaplain, Rev. Edward G. Latch, D.D., offered the following prayer:

*Fear not, for I am with you; be not dismayed, for I am your God; I will strengthen you; yea, I will help you.—Isaiah 41: 10.*

Almighty God, our Father, before we begin the work of this day we turn to You in our morning prayer. We come with hearts filled with gratitude for the opportunity of serving our country in this House. Grant that Your spirit of wisdom and truth may guide us in these critical hours as we plan for the future of our Republic. Help us to think the thoughts, possess the emotions, and do the deeds which become us as leaders of this great land.

May we ever be true to the high principles upon which our Nation was founded, may we ever hold high our enthusiasm for life, liberty, and the pursuit of happiness and may we ever keep our concern for the needy, the poor, and the oppressed.

Grant that good will and justice may live in every heart and increasingly prevail in our planet. Together may we do justly, love mercy, and walk humbly with You. Amen.

## CALL OF THE HOUSE

Mr. ROUSSELOT. Mr. Speaker, under rule 1, clause 1, of the rules of the House, I make the point of order that a quorum is not present.

The SPEAKER. Evidently a quorum is not present.

Without objection, a call of the House is ordered.

There was no objection.

The call was taken by electronic device, and the following Members failed to respond:

[Roll No. 752]

Abdnor	Armstrong	Bellenson
Alexander	Ashley	Biaggi
Ambro	Badillo	Bolling

Burton, John	Hammer-schmidt	Ruppe
Cederberg	Harsha	Santini
Chappell	Hawkins	Sarasin
Chisholm	Jones, Tenn.	Scheuer
Cochran	Kasten	Seiberling
Conyers	Kelly	Smith, Nebr.
Crane	Koch	Thone
Cunningham	Krueger	Thornton
Davis	Lundine	Tucker
Dent	McDonald	Udall
Derwinski	Mikva	Van Deerlin
Diggs	Moss	Wampler
Dingell	Myers, John	Waxman
Duncan, Oreg.	Nolan	Whalen
Fithian	Pike	White
Ford, Mich.	Pursell	Wilson, Tex.
Frey	Rangel	Rosenthal
Goodling		

The SPEAKER. On this rollcall 371 Members have recorded their presence by electronic device, a quorum.

By unanimous consent, further proceedings under the call were dispensed with.

## THE JOURNAL

The SPEAKER. The Chair has examined the Journal of the last day's proceedings and announces to the House his approval thereof.

Without objection, the Journal stands approved.

There was no objection.

## MESSAGE FROM THE SENATE

A message from the Senate by Mr. Sparrow, one of its clerks, announced that the Senate had passed without amendment a concurrent resolution of the House of the following title:

H. Con. Res. 417. Concurrent resolution commending Anwar el Sadat, the President of Egypt, and Menachem Begin, the Prime Minister of Israel.

The message also announced that the Senate agrees to the amendment of the House to the amendment of the Senate numbered 5 and receded from its amendment numbered 6 to a bill of the House of the following title:

H.R. 1904. An act to suspend until July 1, 1980, the duty on intravenous fat emulsion.

The message also announced that Mr. DANFORTH be a conferee, on the part of the Senate, on the bill (H.R. 9346) entitled "An act to amend the Social Security Act and the Internal Revenue Code of 1954 to strengthen the financing of the social security system, to reduce the effect of wage and price fluctuation on the system's benefit structure, to provide for the conduct of studies with respect to coverage under the system for Federal employees and for employees of State and local governments, to increase the earnings limitation, to eliminate certain gender-based distinctions and provide for a study of proposals to eliminate dependency and sex discrimination from the social security program, and for other purposes," vice Mr. LAXALT, excused.

## DR. ORRIN E. HUDSON, SR.

(Mr. HUBBARD asked and was given permission to address the House for 1 minute and to revise and extend his remarks.)

Mr. HUBBARD. Mr. Speaker, it is with genuine sadness that I speak today in the House of Representatives regarding a friend and supporter of many years, Dr. Orrin E. Hudson, Sr.

Dr. Hudson, age 74, of Madisonville, Ky., died there at Hopkins County Hospital November 19 following an apparent heart attack.

He was a complement to many constructive interests in Madisonville. The impressions he tendered upon those around him will endure for years to come. He was an outstanding family man, a faithful churchman, and worked for progress in his community.

Dr. Hudson, a native of Golden, Ill., came to Madisonville following his 1944 graduation from Palmer College of Chiropractic in Davenport, Iowa. During his practice he served on the board of